

WHAT IS CLAIMED IS:

1. An atomic oscillator whose resonance frequency derives from atomic transitions, the oscillator comprising:

(a) a voltage-controlled oscillator that produces an oscillation signal based on a given control voltage;

(b) a radio-frequency (RF) signal synthesizer that produces an RF signal, comprising:

a modulator that modulates the oscillation signal with a given low-frequency signal,

a phase-locked loop (PLL) that directly produces a first frequency in an atomic resonance frequency band in synchronization with the modulated oscillation signal, the first frequency being an integer multiple of the frequency of the oscillation signal given by said voltage-controlled oscillator,

a frequency synthesizer that creates a second frequency by using the oscillation signal as an input clock signal, the second frequency being specified by a frequency control word, and

a mixer that mixes the first and second frequencies to produce the RF signal;

(c) an atomic resonator in which atoms in an electromagnetic field of the RF signal interact with discharge lamp light passing therethrough, depending on a

difference between the RF signal frequency and atomic resonance frequency, said atomic resonator having a sensor that produces a resonance detection signal representing the amount of unabsorbed discharge lamp light;

5 (d) a frequency controller that produces the control voltage by performing synchronous detection on the resonance detection signal; and

10 (e) a frequency setting unit that sets the frequency control word to specify the second frequency of  
10 said frequency synthesizer.

2. The atomic oscillator according to claim 1, wherein the second frequency produced by said frequency synthesizer is offset frequency of the first frequency  
15 with respect to the atomic resonance frequency.

3. The atomic oscillator according to claim 1, wherein said frequency setting unit varies the frequency control word according to an external control signal.

20 4. The atomic oscillator according to claim 1,  
wherein:

25 said frequency setting unit comprises a temperature sensor to measure ambient temperature; and

said frequency setting unit varies the frequency control word according to ambient temperature measurements to compensate for temperature dependence of the discharge

lamp light and thereby regulate the frequency of the oscillation signal.

5. The atomic oscillator according to claim 1,  
5 wherein said frequency setting unit varies the frequency control word according to the resonance detection signal to compensate for age deterioration of the discharge lamp light and thereby regulate the frequency of the oscillation signal.

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6. An atomic oscillator whose resonance frequency derives from atomic transitions, the oscillator comprising:

(a) a voltage-controlled oscillator that  
15 produces an oscillation signal based on a given control voltage;

(b) a radio-frequency (RF) signal generator that produces an RF signal, comprising:

20 a phase-locked loop (PLL) that directly produces a first frequency in an atomic resonance frequency band in synchronization with the oscillation signal, the first frequency being an integer multiple of the frequency of the oscillation signal,

25 a frequency synthesizer that creates a second frequency by using the oscillation signal as an input clock signal, the second frequency being specified by a frequency control word and modulated with a given low-

frequency signal, and

a mixer that mixes the first and second frequencies to produce the RF signal;

(c) an atomic resonator in which atoms in an electromagnetic field of the RF signal interact with discharge lamp light passing therethrough, depending on a difference between the RF signal frequency and atomic resonance frequency, said atomic resonator having a sensor that produces a resonance detection signal representing the amount of unabsorbed discharge lamp light;

(d) a frequency controller that produces the control voltage by performing synchronous detection on the resonance detection signal; and

(e) a frequency setting unit that sets the frequency control word to specify the second frequency of said frequency synthesizer.

7. The atomic oscillator according to claim 6, wherein the second frequency produced by said frequency synthesizer is offset frequency of the first frequency with respect to the atomic resonance frequency.

8. The atomic oscillator according to claim 6, wherein said frequency setting unit varies the frequency control word according to an external control signal.

9. The atomic oscillator according to claim 6,

wherein:

    said frequency setting unit has a temperature sensor to measure ambient temperature; and

5    said frequency setting unit varies the frequency control word according to ambient temperature measurements to compensate for temperature dependence of the discharge lamp light and thereby regulate the frequency of the oscillation signal.

10           10.    The atomic oscillator according to claim 6, wherein said frequency setting unit varies the frequency control word according to the resonance detection signal to compensate for age deterioration of the discharge lamp light and thereby regulate the frequency of the  
15 oscillation signal.